

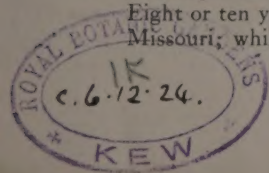
APPLE BLOTCH CONTROL IN MISSOURI

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Fig. 1.—Apples showing the different stages of the apple blotch fungus. Fruits at left show beginning and development of infection, while those at right show severe infection accompanied by the cracking of the flesh.

The apple blotch disease has become more injurious to apple production in Missouri than any other fungous disease of the apple fruit. This is particularly true in the southern half of the State. The blotch has spread rapidly. Eight or ten years ago the disease was seldom observed in Central and North Missouri; while it is now found in most of the orchards of the State, and



certainly no apple growing district is entirely free from infection. In some orchards of the Ozark Region of Southwest Missouri as much as 75 per cent of the apple crop is often affected.

APPEARANCE AND DISTRIBUTION

The first recorded appearance of the disease was in 1895, upon the leaves of the wild crab and on apple fruit. It is believed, however, that the disease was present in the "Blotch Belt" and injurious to apples long before this date. At first it was confused with other fungous diseases of the apple, particularly apple scab, and was known by a variety of names. Blotch does not attack other fruits, but is known to occur only on the apple, including the native species of crab apple.

The blotch is confined to the central and southern states of the eastern half of the United States. The best authorities agree that the disease now infests about one-half of the apple producing area of the country. The greatest damage has been reported from Arkansas, Missouri, Oklahoma, Kansas, Southern Illinois, Indiana and Ohio.

BLOTCH IS CAUSED BY A FUNGUS

The apple blotch disease is caused by a fungus technically known as *Phyllosticta solitaria*—E. and E. The disease may be characterized as a parasitic mold which grows within the tissues of the fruit, twig and leaf and produces the characteristic spots or lesions.

The fungus is a plant and is spread by means of spores or microscopic bodies. Germination of these spores and the resulting growth are similar to the multiplication of the higher plants by means of seeds. For example, when the spores or seeds of the blotch fungus are deposited upon the apple, leaf or twig, they will germinate and grow if temperature and moisture conditions are suitable. From the tiny spores or seeds grow little roots known as mycelium. These penetrate the tissues of the fruit, leaf or branch and cause the condition known as blotch infection.

It is evident, therefore, that for sprays to be effective in the control of the disease, they must be applied before the mycelium of the spores penetrates the fruit or leaf surface. Continued protection from the disease lies in the fact that a thin covering of the spray is kept upon the surface of the fruit, foliage and branches and the spores alighting upon them are, as they germinate, destroyed by the poisoning action of the spray. From three to five sprays, applied at intervals of about two weeks after the petal fall or calyx spray, may be necessary for best results.

HEAVY LOSSES CAUSED BY BLOTCH

Unsprayed and poorly sprayed orchards are frequently made unprofitable by the attack of this disease. Orchards planted to susceptible varieties suffer worst. Blotch frequently cracks the fruit, thus permitting the entrance of fruit rots which are very destructive. The disease may also girdle and kill fruit spurs and twigs, destroy fruit buds and cause the dropping of leaves.

According to the best information, the loss in 1920 ranged between 5 and 10 per cent of the apple crop. The estimated loss in the blotch territory of the United States is placed at 5,200,000 bushels. A conservative estimate

of the loss to the Missouri apple crop in recent years would be about 200,000 bushels annually.

SUSCEPTIBILITY OF VARIETIES

At the present time some of the varieties grown in Missouri which are most susceptible to blotch may be listed as follows: Smith Cider, Missouri Pippin, Mann, Oldenburg (Duchess), Maiden Blush, Benoni, Ben Davis and Willow. The disease has been reported as serious upon many more varieties. Perhaps there are no varieties that are entirely immune to the disease, but the following have shown marked resistance under Missouri conditions: Grimes, Jonathan, Delicious, York, Winesap and Staymen. All of these are standard commercial varieties in Missouri.



Fig. 2.—Blotch cankers on water sprouts from 1 to 3 years of age.

Most of the observations regarding the susceptibility of different varieties have been based upon the severity of the infection upon the apple fruit. Since the spread of the disease from one year to the next is from the canker formations on the twigs and branches, it is highly important that the growers plant in their orchards those varieties which do not form blotch cankers readily. The Missouri Pippin and Oldenburg (Duchess) are among the most susceptible to canker formation, while the Jonathan and Winesap are among the most resistant.

APPEARANCE UPON THE FRUIT, LEAF AND SHOOT.

The first appearance of the disease upon the fruit is indicated by the development of tiny, brownish specks which soon become larger and darker.

These tiny specks may frequently be observed as early as the first half of June. As the submerged, irregular, dark brown areas become larger they assume a star-shape appearance with haggled and uneven margins. Toward the end of the growing season large irregular blotch spots may be scattered over the entire surface of the fruit, causing it to crack.

In the beginning, the effect of the fungus upon the leaves causes many very small, light colored, pin-head specks. These grow rapidly, coalesce and may involve the entire leaf surface, including the veins and leaf stem, in which case the leaves may drop prematurely. Many apples drop before they mature, others crack badly, and those that remain may not be worth harvesting. Where the attack is serious, partial or complete defoliation of the trees may occur in late summer.

The appearance of the blotch upon the water sprouts and tender shoots is similar to that upon the fruit. As the blotch grows older, the affected areas become darker in color and rougher in appearance.

SOURCE OF THE BLOTCH

The canker stage of the disease found upon the twigs and branches harbors or holds over the fungus through the winter. It is highly important that every grower be made aware of this fact, as much injury may be prevented by removing the affected parts when pruning.

During the warm weather of early spring, spores ooze out from the cankers and are washed and spattered by rain drops to the leaves and fruit, where infection occurs. There may be a secondary infection occurring from the first, but the greatest spread appears to come from the cankers on the suckers, watersprouts, twigs and branches.

The cankers on the twigs and branches may live from 10 to 14 years and spread spores each spring and early summer. The advancing margins of the cankers are the source of the spores. The canker stage is particularly serious upon suckers and watersprouts. It is very essential that an extra effort be made to eliminate such infected portions in pruning.

Investigations have shown that twig cankers may result from infected leaf stems or petioles. When the base of the leaf stem becomes affected, the fungus may cross over to the twig to which the leaf stem is attached. Fortunately for the fruit grower, proper spraying will prevent leaf and stem infection.

TIME OF INFECTION AND WEATHER

Infection from the spread of the spores in the spring will seldom start earlier than 14 days after the petal fall. It is also true that the major portion of the infection occurs during a period of about seven weeks following the petal fall or calyx period.

Wet weather favors the blotch, while dry weather tends to hold it in check. In orchards where twig cankers are abundant, however, dry weather will not prevent damage to the fruit and foliage.

EFFECT OF SPRAYING IN THE CONTROL OF BLOTCH

Spraying is the most important single method for the control of blotch. Thorough applications made at the proper time and with the right mixture will prevent fruit, twig and leaf infections.

Since the first blotch spores are seldom spread earlier than 14 days after the petal fall, the first spray for the control of the disease should be made within this period. If the application is made several days later, good results may not be secured. Bordeaux has given better results in the control of blotch than any other spraying chemical. The spray made according to the 3-4-50 formula has been found to be very satisfactory.

Lime-sulphur has controlled light infections of the blotch. It has not, however, given satisfactory control where the disease was serious. Lime-sulphur and arsenate of lead are used by practically all growers for the petal fall or calyx spray, because bordeaux is apt to russet the fruit badly if used at this time. When used in 10 days after the calyx spray it often does considerable damage. For this reason, when bordeaux is used so soon after the petal fall period, the 2-4-50 formula is often employed instead of the 3-4-50. If it is necessary to make an application in 10 days, lime-sulphur 1 or $1\frac{1}{4}$ to 50 is much safer from the standpoint of burning or russetting the fruit.

Bordeaux sprays (3-4-50) applied at intervals of two, four, and six weeks after the petal fall or calyx spray should give satisfactory results in Central and North Missouri. In South Missouri, on account of the longer growing season, as many as four or five applications of bordeaux may be required at intervals of 12 to 14 days after the petal fall. Most growers apply too few, rather than too many, sprays. Where the disease is serious, it is important that the sprays be continued at intervals of about two weeks until the middle of July or later.

FIRST BLOTCH SPRAY 12 TO 14 DAYS AFTER CALYX

It should be remembered that the first and most essential spray for the control of blotch is the one following the petal fall spray and that for the best protection, the applications should be made within 14 days. When the petal fall is delayed due to cool weather the first blotch application should be made within 10 or 12 days. The early sprays are the most needed in blotch control and should consist of bordeaux instead of lime-sulphur, because bordeaux is more effective in the control of the disease.

THOROUGH AND TIMELY SPRAYING

Thoroughness in spraying and timeliness of application are of equal importance in blotch control. No orchardist can hope to control blotch if he neglects either. Thorough and timely spraying cannot, therefore, be urged too strongly. Every apple, leaf and twig, must be hit by the spray and covered on all sides; otherwise, protection from injury will not be secured.

Apple trees from 12 to 15 years of age will generally require from 5 to 7 gallons of spray to make a thorough application; while trees from 18 to 25 years old, or older, may need from 12 to 20 or more gallons of spray to cover the fruits, leaves and branches properly.

SECOND SUMMER, OR CALYX SPRAY

The petal fall or calyx spray should always be applied for the control of codling moth, curculio, canker worm, scab, leaf spot and other insects and diseases harmful to the fruit and foliage.

On account of the danger of russetting or burning the young tender fruit, bordeaux is seldom used for this spray. Lime-sulphur, diluted at the rate of $1\frac{1}{4}$ or $1\frac{1}{2}$ gallons to 50 gallons of water, is usually employed.

Arsenate of Lead.—Because of the necessity of controlling such insects as the codling moth, curculio, canker worm and other insect pests which bite and chew, arsenate of lead is usually required in every spray. It is generally used at the rate of 1 pound to 50 gallons of bordeaux or lime-sulphur spray.

The arsenate of lead may be purchased in two forms, dry form and paste form. Nearly all growers now use the dry form, as it is lighter and no trouble is experienced from evaporation, as is true with the paste form. Since the paste form contains about 50% water, twice as much should be used as for the dry form.

In using either the paste or powder, it is advisable to mix the poison in a small quantity of water, stirring until it becomes a thin paste before adding it to the spray barrel or tank. To prevent the arsenate of lead from settling to the bottom of the spray barrel or tank, after which it is often difficult to stir it up again, the poison should not be added to the spraying solution until just before the work begins.

The common method is to nearly fill the tank with the spray mixture, after which the arsenate of lead, already thoroughly mixed with about a gallon of water, is added. Where power outfits are being used, it is advisable to start the engine when the arsenate of lead is added, in order to keep the solution thoroughly agitated until the spray is applied. If the arsenate of lead is added to the spray just before driving to the orchard, the solution is usually agitated sufficiently by the jolting of the barrel or tank to prevent it from settling.

EFFECT OF PRUNING IN THE CONTROL OF BLOTCH

Since the blotch fungus is carried over the winter on the twigs, spurs and branches, all parts showing infection should be removed during the regular pruning work. Where cankers are found on branches which it is not desirable to remove, the affected bark should be shaved off with a sharp knife. The cuts may be made deep enough to remove all the affected area or discolored bark tissue without doing injury to the cambium or growing layer beneath. Disinfectants or wound dressings are not generally needed. The work of pruning and shaving of cankers should be done every year, because some may be overlooked and new ones may develop each year.

The nurseryman should examine his stock carefully and withhold from sale trees showing blotch cankers. He should also apply the blotch sprays in growing the trees. It is important that the seedling stock for grafting and budding purposes be free from the disease. To be on the safe side, the scion orchard should be rid of the blotch cankers. Scions showing infection should be refused. This is worth while, because the spread of blotch to young orchards may often be traced to infected nursery stock.

SPRAYING YOUNG TREES

Young trees may be protected from a serious spread of the blotch by applying from two to four bordeaux sprays at intervals of about two weeks. The applications should be made at the periods for the early blotch sprays in bearing orchards. It is usually necessary and advisable to spray the young trees to control other diseases and insect pests. The extra growth and development of the young trees as a result of the application of the sprays will more than pay the cost of materials and labor.

STANDARD SPRAYING MIXTURES: FORMULAS AND PREPARATION

Bordeaux.—Where only a small quantity of bordeaux is desired, it may often be best to purchase the prepared product, although it is not difficult to make bordeaux in small quantities. In using prepared spraying chemicals it is very important that the grower follow the directions given on the containers.

If as much as 200 or 300 gallons of bordeaux is needed, better results will generally be secured by making the spray mixture on the farm. The following formula and method of preparation has given satisfactory results in Missouri:

Blue vitriol (copper sulphate)	3 pounds
Stone lime	4 pounds
or	
Hydrated lime	6 pounds
Water	50 gallons

(Only the highest grade of lime should be used.)

Making Stock Solutions.—The number of pounds of copper sulphate needed may be placed in a gunny sack or cloth bag and hung in a barrel or keg of water so that it is just below the surface of the water. When this is done in the evening, practically all of the copper sulphate will be dissolved by morning. Then add sufficient water to make 1 gallon for each pound of copper sulphate used. This will give 1 pound of copper sulphate to each gallon of water.

If hydrated lime is used, the copper sulphate stock solution is the only one needed. The amount of hydrated lime required for each barrel or tank should be mixed with a little water and stirred into a thin paste, after which it is ready to be poured through the strainer into the spray barrel or tank.

When stone lime is used, slake the required amount in just enough water to make a thin paste. Stir and mix thoroughly, after which add sufficient water to make 1 gallon of water to each pound of lime used.

The stock solution of copper sulphate will keep indefinitely if evaporation is prevented. The lime stock solution will deteriorate after long exposure. Where evaporation does occur, water should be added before using, to bring the dilution to 1 pound to each gallon.

Mixing.—According to the above formula, 3 gallons of the copper sulphate stock solution and 4 gallons of the lime stock solution, or 6 pounds of the hydrated lime made into a thin paste, will be required for each 50 gallons of bordeaux to be made. Fill the spray tank about two-thirds full of water and start the agitator. Pour through the strainer 3 gallons of the copper sulphate stock solution for every 50 gallons of spray. Add 4 gallons of the lime stock solution or 6 pounds of hydrated lime made into a thin paste to every 50 gallons of spray. Then add enough water to bring the volume up to the required amount. For best results, the mixture should be used at once, since bordeaux deteriorates rapidly in a few hours. Each spray tank should be made up as it is used.

POINTS TO BE REMEMBERED IN BLOTCH CONTROL

1. Spray with bordeaux, 3-4-50, and arsenate of lead within 14 days after the petal fall or calyx spray.
2. If the petal fall is late for any reason, apply this first bordeaux spray within 10 or 12 days.
3. Bordeaux sprays applied two, four and six weeks after the petal fall are effective in preventing injury to fruit and foliage in Central and North Missouri. This spraying program makes allowance for three blotch sprays and two earlier sprays, making a total of five summer sprays.
4. In the southern and southwestern parts of the State, four or five blotch sprays following the petal fall spray are required. Counting the cluster-bud and calyx sprays, a total of six or seven sprays are needed, and for best results they should be applied at intervals of 12 to 14 days.
5. Lime-sulphur, $1\frac{1}{2}$ to 50 gallons of water, has not given as good results in the control of blotch as bordeaux. Practically every grower uses lime-sulphur and arsenate of lead for the petal fall or calyx spray because bordeaux usually russets the fruit badly if used at this time.
6. Spraying is the cheapest and best insurance against blotch. The grower cannot afford to omit a single application if it is needed. When in doubt, spray. It will mean more bushels and dollars at harvest time.
7. When pruning, remove blotch cankers on watersprouts, fruit spurs and branches. These cankers carry the disease over from one season to the next. The destruction of these holdover cankers will aid greatly in the control of the disease.
8. It is often profitable to remove very susceptible and badly infected apple varieties to prevent the spread of the disease in the orchard.
9. Plant resistant, uninfected, vigorous trees. This will reduce greatly the expense of blotch control. It will also prevent early infection and later damage to the fruit.
10. Where blotch is prevalent, young apple trees should be sprayed with bordeaux two or three times each season to prevent blotch infection. If this is done, less difficulty will be experienced in controlling the disease when the trees come into bearing.
11. The wild crab apple may be a source of blotch infection. Where infected trees grow near orchards they should be destroyed.